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# CRUSHING COALS FOR COKING.

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Koks i Khimiya, 1957, No.8, pp. 7-10.

Methods of crushing must be selected in coal preparation plants in such a way as to affect the screen analysis of the charge in the desired direction.

A number of investigators recommend to separate from the charge the 0.5 mm max. fraction for improving coke quality. This problem is difficult to solve practically, since it calls for the use of additional equipment and a considerable consumption of electric energy.

The DSh scheme of coal preparation recommended by I. M. Lazovskii et al. (1) and the scheme presently employed at the coal preparation plants of the South do not permit to exert any effect on the screen analysis of the charge.

Mechanical strength of gas coals is considerably higher than the mechanical strength of all other charge components. For obtaining the desired standards of charge crushing, the plants are forced to adjust the crushing practice basing on the strongest coals, namely gas coals. Even under these conditions the largest components of the charge consist mainly of gas coals. Many attempts of avoiding the presence of gas coals in the larger fractions of the charge led to a considerable decrease of crushers production and an increased content of 0.5 mm fraction in the charge.

According to the data of Aronov and Kulyasov (2) as well as of the results of the study of crushing Donets coals conducted by Miroshnichenko et al. (3) one must conclude that the coals of the middle stage of metamorphism,

namely bituminous, coking and lean caking coals, are crushed in the charge with the formation of a large amount of dust. In the same paper Aronov et al. propose to reduce considerably the dusting of the above coals by changing the configuration of the hammers of the mills. Any attempts directed towards reducing of dust formation during crushing of the charge will always lead to an insufficient crushing of the gas coals and lowering of the quality of the charge.

Coals which are mechanically stronger must be crushed, therefore, separately. Only under these conditions the amount of dust in the charge can be reduced.

V. Zashkvara et al. (4) as well as A. Miroshnichenko et al. (5) did not record any improvement in coke quality on increasing comminution of the gas coals since, in this case, the screen analysis of the charge deteriorated on account of overcrushing of its other components.

The presence in the charge of particles of gas coals larger than 3 mm lowers coke quality. On this account, Aronov et al. (2) recommend separation of the larger fractions of gas coals for their subsequent recrushing and returning to the charge. Such a proposition would require the installation of an exceptionally bulky equipment. Separate crushing of the gas coals permits their elimination from the components of charge larger than 3 mm.

Our opinions regarding the new scheme of coal crushing were supported by experiments conducted on a production scale at the Baglei coking plant.

For individual comminution of gas coals were used crushers of the grinding installation intended for lean coals. Crusher capacity for the lean coals amounted to 80 tons/h at 1460 r.p.m. when a rotor 1000 mm diameter and 1000 mm long was used.

During these experiments the composition of the charge was: 16% gas coal, 44 bituminous coal, 22 coking coal, 18% lean caking coal

Screen analysis of the gas coals before and after crushing, production of the crusher, and energy consumption are given in Table 1.

Table 1. Indices of crushing of Donets gas coal

| Time of experiment (1957) | 3/19 | 3/20 | 3/24 | 4/2 | 4/3 | 4/5 | 4/10 | 4/15 | 4/21 |
|---|---|---|---|---|---|---|---|---|---|
| Screen analysis (5) before crushing, mm | | | | | | | | | |
| 25 min. | 13.1 | 11.5 | 6.5 | 11.5 | 6.5 | 15.6 | 12.6 | 11.0 | 23.6 |
| 25-10 | 28.2 | 23.0 | 24.0 | 31.6 | 16.1 | 25.7 | 28.3 | 17.0 | 30.3 |
| 10-6 | 26.6 | 18.4 | 17.6 | 21.5 | 24.2 | 20.9 | 24.5 | 29.5 | 10.4 |
| 6-3 | 12.9 | 14.3 | 13.1 | 11.9 | 17.0 | 12.3 | 13.0 | 20.0 | 12.3 |
| 3-0 | 19.2 | 32.8 | 38.8 | 23.5 | 36.2 | 25.5 | 21.6 | 22.5 | 23.4 |
| Screen analysis after crushing mm | | | | | | | | | |
| 6 min. | 0.5 | 1.6 | 0.3 | 0.7 | 0.6 | 0.8 | 0.8 | 1.1 | 0.7 |
| 6-3 | 2.5 | 5.1 | 2.4 | 2.6 | 2.8 | 3.6 | 3.2 | 4.7 | 3.1 |
| 3-2 | 9.0 | 10.8 | 6.7 | 6.4 | 10.6 | 10.5 | 6.9 | 9.4 | 8.6 |
| 2-1 | 8.3 | 8.1 | 7.6 | 6.6 | 5.0 | 6.7 | 6.5 | 8.5 | 7.2 |
| 1-0.5 | 7.4 | 7.9 | 17.0 | 14.7 | 10.4 | 12.3 | 15.3 | 16.1 | 16.4 |
| 0.5-0.3 | 11.4 | 9.5 | 16.1 | 15.8 | 10.3 | 12.8 | 14.6 | 16.4 | 17.2 |
| 0.3-0 | 60.9 | 57.0 | 49.9 | 53.2 | 60.3 | 53.3 | 52.7 | 43.8 | 46.8 |
| 3-0 | 97.0 | 93.3 | 97.3 | 96.7 | 96.6 | 95.6 | 96.0 | 94.2 | 96.2 |
| Crusher production, tons/h | 67.5 | 64.7 | 58.2 | 51.6 | 45.1 | 65.1 | 43.0 | 71.3 | 41.0 |
| Energy consumption, KWH/h | - | 4.08 | 5.15 | 7.34 | 6.65 | 4.32 | 5.13 | - | 5.10 |

The moisture content of the gas coal which was crushed varied between 9 and 11%. The 0.5 mm max. fraction content in the run-of-mine gas coal amounted to 8.3% and in the crushed one to 66.4%. In this light, the increase of the dust content in the charge on account of gas coals previously crushed increases about 10%.

For reducing dust content of the charge, gas coals must be crushed separately. The following scheme may be recommended for this:

Gas coal is comminuted until 80% of it is smaller than 3 mm and then is fed into a dust eliminating apparatus for separating the 2 mm min. or 3 mm min. fraction. The latter is returned for regrinding, and the 2 mm max (or 3 mm max)

fraction is added to the remaining components of the charge for a final combined grinding and mixing.

The proposed technological crushing scheme of separate crushing of gas coals can guarantee obtaining a maximum content of particles of medium size which assures the production of coke of a uniform structure. At the time, an opportunity for a larger utilization of gas coals for coking is offered.

For a separate crushing of the gas coals according to the proposed scheme, the moisture content of the gas coals must be reduced to 4-5%. This would require building thermal driers at the coal washing installations. Taking account of a pronounced efficiency obtainable with the introduction of the new scheme of coal crushing, it appears to be advantageous to install thermal driers, even when only coal preparation shops are available.

From Table 1 one can see that on crushing gas coals until 94-97% is smaller than 3 mm, the charge content of gas coal particles larger than 3 mm will be below 0.5%. Such an index cannot be obtained when all charge components are comminuted together even when the production of crushers is reduced to that of disintegrators.

In Table 2 is given screen analysis of insufficiently crushed charge after the mixing of the remaining components with crushed gas coal.

Table 2. Screen analysis of the charge to which separately crushed gas coals were added.

| Test No. | Content (%) of the sizes, mm | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 25 min | 25-10 | 10-6 | 6-3 | 3-2 | 2-1 | 1-05 | 0.5-0.3 | 0.3 max. |
| 1 | 3.9 | 9.6 | 9.4 | 11.7 | 10.4 | 9.0 | 12.4 | 9.8 | 23.8 |
| 2 | 2.9 | 12.6 | 8.1 | 11.6 | 11.0 | 8.9 | 12.9 | 8.9 | 23.1 |
| 3 | 3.2 | 8.5 | 8.7 | 11.4 | 14.1 | 7.8 | 13.8 | 9.4 | 23.1 |
| 4 | 3.0 | 5.1 | 10.5 | 12.6 | 14.2 | 7.0 | 14.8 | 10.5 | 22.3 |
| 5 | 2.0 | 5.4 | 7.8 | 12.7 | 12.5 | 9.6 | 16.6 | 12.0 | 21.4 |

Average dust content of uncrushed charge is 33.1%. As it has been pointed out above, 10% of the dust is brought by the crushed gas coals. The remaining dust (23%) is introduced with the uncrushed components of the charge.

A high dust content in run of mine bituminous, lean caking and coking coals is explained by the use of mechanization in coal mining. The question of lowering dust content in mining coals intended for coking should be a subject of a special study. The task of the coal preparation plants workers lies in reducing dusting during coal preparation. Starting with the theory of crushing, one has to maintain for this two conditions: the maximum charging of the crushing devices and lowering the degree of charge comminution.

These conditions were used as a basis for testing standard crushers measuring 1450 x 1300 mm using a charge composed of previously ground gas coals. The data of these tests are presented in Table 3.

Table 3. Indices of testing standard crushers.

| Variation | 1 | 2 | 3 |
|---|---|---|---|
| Crusher production, tons/h | 278 | 385 | 495 |
| Percentage of fraction (mm) in the charge | | | |
| 6 min. | 1.6 | 2.4 | 5.3 |
| 6-3 | 5.4 | 5.8 | 7.7 |
| 3-2 | 10.1 | 10.5 | 13.1 |
| 2-1 | 8.2 | 8.2 | 9.8 |
| 1-0.5 | 17.8 | 16.8 | 19.1 |
| 0.5-0.3 | 14.4 | 14.0 | 17.1 |
| 0.3 max | 42.5 | 42.3 | 27.9 |
| 3 max | 93.0 | 91.8 | 87.0 |
| Yield of volatiles of 3 mm min size,% | 25.27 | 27.14 | 25.90 |
| Total consumption of energy including crushing of gas coals,KWH/ton | 1.47 | 1.56 | 1.50 |

The variations given in Table 3 differ only by the degree of charge comminution, i.t. by its content of the 3 mm max. fraction.

Under conventional production conditions when all components of the

charge are ground together the production of the crusher amounts to about 170 tons per hour. It means that the preliminary crushing of the gas coals increases crusher production 2 to 3 times. On this account, the scheme involving the preliminary crushing of gas coals requires less electricity consumption per ton of charge.

Attention is called to the low yield of volatiles from the 3 mm min. fraction of the charge in all three variations. This indicates that into this fraction pass principally coals of the bituminous and coking type which undoubtedly should improve the coke quality as compared with conventional crushing practice when the larger fractions of the charge consist substantially of gas coals.

On this account, there is no point to comminute the charge generally to 91-93% under 3 mm, since side by side with the increased fines of grinding occurs a sharp increase of dust content in the charge.

The third variation should be considered as optimum. With this practice, the dust content of the charge is lowered by 12% as compared with the first two variations. The total dust content of the charge according to this variation is 45%. With the simultaneous grinding of all components the dust content of the charge usually runs 60-65%. By crushing gas coals differentially, it would be possible to reduce the dust content of the charge to 38-40%, i.e. to such an amount as obtained by comminuting coal in disintegrators.

The bulk density of the charge made according to third variation is 3 to 3.5% higher than of the charge in which all components are ground together.

The coal preparation plant at the Bagley plant worked with the third variation for several days. Coke produced by this modification was not, however, carefully investigated. This must be done in the near future; its behavior in the blast furnaces should be determined.

At the same time it must be necessary to demonstrate to what extent the percentage proportion of the gas coals can be increased in case of their preliminary crushing while retaining the quality of the coke.

Conclusions:

1. The presently used technological schemes of crushing the charge, as well as the excessively severe standards of fineness used should be re-examined.

2. Standards for charge crushing fineness should be supplemented by the index of its content of particles under 0.5 mm.

3. Separate crushing of gas coals is proposed.

4. Crushing of the gas coals is recommended to continue until 80-85% of particles smaller than 3 mm are produced, after which the fraction of 2 mm to 3 mm max should be separated and mixed with the remaining components of the charge while coal with particles larger than 2 mm to 3 mm should be re-crushed.

5. Final crushing (and mixing) of all components of the charge in a standard crusher (1450 x 1300 mm) should be done with the crusher load of 450-500 tons per hour.

BIBLIOGRAPHY.

1. I. M. Lazovskii, et al. Koks i Khimiya, 1956, No.1.

2. S. G. Aronov and V. A. Kulyasov, Koks i Khimiya, 1955, No.2.

3. A. M. Miroshnichenko et al. Study of Friability of Donets Coals, Trudy IKhIN, 1951.

4. V. G. Zashkvara et al. Stal', vol. 14, No.6, (1954).

5. A. M. Miroshnichenko et al. Introduction of gas coals into charges of coke plants of the South of USSR. Trudy UKhIN, 1951.